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Information Technology and Bilateral FDI: Theory and Evidence

Bang Nam Jeon
Drexel University

Linghui Tang
The University of Southern Mississippi

Lei Zhu
Drexel University

Abstract

This paper investigates the impact of communication cost on the FDI activities of multinational corporations (MNCs). First, we provide a theoretical foundation for a gravity-type FDI model, which shows that physical distance and communication technology are important determinants of FDI activities. Second, we apply the IT-augmented gravity model to bilateral FDI data for a total of 47 OECD and non-OECD countries from 1980 to 1997 and find that distance is negatively related to inward FDI stocks while the growth of IT, measured by teledensity and celldensity, has encouraged FDI significantly. The impact is found to be more prominent on FDI from G7 countries to OECD countriesthan to non-OECD countries, and more prominent in the 1990s than in the 1980s. Moreover, IT plays a more effective role by reducing communication cost when distance is beyond a threshold range.

Keywords: communication cost, FDI, distance
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* Correspondence Address: Bang Nam Jeon, Department of Economics and International Business, Bennett S. LeBow College of Business, Drexel University, Philadelphia, PA 19104, U.S.A. (Tel) (215) 895-2125, E-mail: jeonbana@drexel.edu; Linghui Tang, Department of Economics, Finance, and International Business, College of Business and Economic Development, The University of Southern Mississippi, Hattiesburg, MS 39406, U.S.A. (Tel) (601) 266-6612, E-mail: linghui.tang@usm.edu; Lei Zhu, Department of Economics and International Business, Bennett S. LeBow College of Business, Drexel University, Philadelphia, PA 19104, U.S.A. (Tel) (215) 895-2123, E-mail: lz24@drexel.edu.

1. Introduction

The existing literature on multinational corporations (MNCs) has long recognized the importance of headquarter services, which provide knowledge-based and knowledge-generating activities (Markusen, 1984 and 1995, Markusen and Venebles 1998). Examples of headquarter services include R&D, financial management, technology know-how, marketing skills, and so on. It is assumed that these intangible assets can be transferred and shared by multiple production facilities with little cost. In other words, the existing theory suggests distance does not matter for the emergence of MNCs, especially for horizontal MNCs when there is no trading of goods. However, empirical evidence almost always revealed that physical distance is negatively and significantly related to multinational activities even after controlling for trade and investment costs (Carr *et. al*. 2001).

The purpose of this paper is to offer a new interpretation of the negative role of distance in the FDI activities by MNCs. Unlike the traditional view, we consider distance to represent the communication cost of moving information and knowledge rather than the cost of moving goods for MNCs. As we observe in practice, the transfer of headquarter services through the travel of key personnel or post mail can be costly. The development of modern information technology (IT) provides a more efficient way for sharing information and knowledge within MNCs.

Following the communication cost and international trade model proposed by Harris (1995) and then further developed by Kikuchi and Ichikawa (2002) and Kikuchi (2003), we consider the communication cost for FDI to have two components. First, it is proportional to the distance between the home and host countries with the coefficient

determined by the state of IT in both countries. The second part of the communication cost includes the investment of building a communication network. Our model provides a theoretical justification for using a gravity equation for FDI. That is, multinational activities decrease with distance while increasing with the development of IT and the economic sizes of the home and host countries.

The empirical section of this paper utilizes the recently available bilateral FDI stock data for 27 OECD and 20 non-OECD countries between 1980 and 1997. Applying an IT-augmented gravity model, we find that the relationship between distance and inward FDI stocks is always negative, which is similar to international trade. Most importantly, we find that the increasing density of telephone lines and wireless phones encourage bilateral FDI for all pairs of countries. The impact of IT is found to be greater for FDI from G7 to OECD countries than that to non-OECD countries. Meanwhile, the impact of IT on FDI is more prominent during the 1990s than the 1980s. In addition, IT performs a more important role in reducing the perceived distance when the distance between two countries is greater than a threshold range.

The paper is organized as follows. Section 2 presents the theoretical framework of FDI with communication cost. The empirical test and findings are reported in Section 3. Section 4 provides the conclusions.

2. The Theoretical Framework

This section develops a MNC model with communication costs in the spirit of the multinational theory developed by Helpman and Krugman (1980), Markusen and Venables (1998), and Ethier (1986). For simplicity, we assume there is only one factor

for production: labor. All costs are measured in terms of labor units hereafter. To emphasize the importance of the knowledge-capital model, multinational firms in country i (=1,2) have to decide the level of investment in headquarter services, represented by h_i, in the first stage. Firms will choose output for production in the second stage.

The central assumption of our model is that the transfer of headquarter services to different locations requires communication cost, CC_i. The communication cost has two parts. The first part of CC_i represents the time and expenses needed for exchanging information through the traveling of key multinational personnel and other possible channels. In other words, it is proportional to the distance between the two countries (D) with coefficient $c_i(T_i,T_j)$, where T_i and T_j (i≠j=1,2) represent the state of information technology in country i and country j, respectively, and $\partial c_i / \partial T_i$, $\partial c_i / \partial T_j < 0$. The reason that the technology parameter not only depends on the home country's technology but also the foreign country's technology is due to the joint provision of service requirement for mail and telecommunication services.[1]

The second part of the communication cost is what firms have to pay to be connected to the global network. To accommodate the incoming and outgoing telephone traffic and the level of headquarter services, we assume that the cost to build a communication network infrastructure for country i is proportional to the product of population in country i and country j, L_i*L_j, and the headquarter services h_i. Similar to Harris (1995), it is assumed that parent firms share the home country's infrastructure cost equally. If the number of multinational firms headquartered in country i is m_i, we have the total communication cost for a multinational firm in country i as follows.

[1] See Tang (2003) for a discussion of the institutional arrangement for international communications.

$$CC_i = c_i(T_i, T_j)D \quad + \quad \alpha L_i L_j h_i / m_i \qquad (1)$$

According to equation (1), CC_i is an endogenous variable: it is not only determined by headquarter services h_i, another endogenous variable, but also by the number of multinational firms.

Consider a general equilibrium model with only one sector producing differentiated goods. Both the home and foreign country's national firms are assumed to have the same fixed and marginal production cost, denoted by f and γ, respectively. Furthermore, multinational firms have the same fixed cost as national firms but a different marginal production cost $\gamma_{m_i}(h_i)$, which is determined by the level of headquarter services and $\gamma_{m_i}'(h_i) < 0$. To abstract from the transportation cost and tariffs associated with international trade, the differentiated goods are assumed to be non-tradable.

Now, the cost to produce x units of a differentiated good in terms of labor units l_{i,n_i} and l_{i,m_i} by a national and a multinational firm in country i, respectively, can be written as

$$l_{i,n_i} = f + \gamma x_{i,n_i} \qquad (2)$$

$$l_{i,m_i} = 2f + h_i + \gamma_{m_i}(h_i)x_{i,m_i} + \gamma_{m_i}(h_i)x_{j,m_i} + CC_i \qquad (3)$$

In equations (2) and (3), x_{i,n_i} is the output of a national firm in country i, while x_{i,m_i} and x_{j,m_i} (i≠j) represent the outputs of a multinational firm in the home (i) and foreign country (j), respectively.

Suppose that factor price is equalized and the relative wage rate is normalized to one. Then, the profit functions for a national and a multinational firm in country i are as follows:

$$\pi_{i,n_i} = P_{i,n_i} \cdot x_{i,n_i} - (f + \gamma x_{i,n_i}) \tag{4}$$

$$\begin{aligned} \pi_{i,m_i} = & [P_{i,m_i} \cdot x_{i,m_i} - (f + h_i + \gamma_{m_i}(h_i) x_{i,m_i}) - CC_i] \\ & + [P_{j,m_i} x_{j,m_i} - (f + \gamma_{m_i}(h_i) x_{j,m_i})] \end{aligned} \tag{5}$$

In equations (4) and (5), P_{i,n_i} , P_{i,m_i} and P_{j,m_i} are the prices of goods sold by a national and a multinational firm from country i in the home and foreign country, respectively.

Now, let d_{ik} represent a typical consumer k's consumption of goods in country i. With n_i number of national firms and $(m_i + m_j)$ number of multinational firms, the representative utility function of consumers is

$$U_{ik} = \sum_{ik=1}^{n_i+m_i+m_j} d_{ik}^{\beta} \tag{6}$$

Through utility maximization, it is easy to show that the inverse demand functions in both the home and foreign country is: $P_{ik} = \lambda_i^{-1} \beta d_{ik}^{\beta-1}$, where λ_i is the shadow price on the budget constraint. By plugging in the equilibrium price into equations (4) and (5), we can solve for the profit-maximizing prices, given the level of headquarter services in

the second stage. It can be shown that both the home and foreign country's national firms charge the same price, i.e. $P_{i,n_i} = \beta^{-1}\gamma$ while multinational firms have the same price in both the home and foreign country, i.e. $P_{i,m_i} = P_{j,m_i} = \beta^{-1}\gamma_{m_i}(h_i)$.

Using zero profit and utility maximization conditions, we have the following equilibrium conditions regarding the outputs of national and multinational firms.

$$x_{i,n_i} = f/\gamma(\beta^{-1}-1) \tag{7}$$

$$x_{i,m_i} = x_{j,m_i} = [\gamma_{m_i}(h_i)/\gamma]^{1/(\beta-1)}[f/\gamma(\beta^{-1}-1)] \tag{8}$$

$$x_{i,m_i} + x_{j,m_i} = (2f + h_i + CC_i)/[\gamma_{m_i}(h_i)(\beta^{-1}-1)] \tag{9}$$

Then, multinational firms can figure out the profit-maximizing headquarter services, h_i*. For simplicity, let $\gamma_{m_i}(h_i) = \gamma - \delta h_i$, $\delta>0$. Using backward induction, the optimal level of headquarter services is

$$h_i^* = \gamma/\delta - (\gamma/\delta)[(1+\alpha L_i L_j/m_i)\gamma/(2ft\delta)]^{\beta-1} \tag{10}$$

where $t = \beta/(1-\beta)$

Using equations (8)-(10), the equilibrium number of multinational firms is[2]

$$m_i^* = \frac{\alpha[(\gamma/\delta)^{\beta}\beta k - \gamma/\delta]L_i L_j}{2f + c_i(T_i,T_j)D + (\gamma/\delta) - (\gamma/\delta)^{\beta}k} \tag{11}$$

where $k = 2f^{1-\beta}t^{-\beta}(1-\beta)^{-1}$

[2] We have used Taylor expansion to simplify the non-linear equation to derive the result in equation (11).

The implications we can derive from equation (11) are straightforward. First, the distance between two countries, D, is negatively related to the equilibrium number of multinational firms, m_i*, which is an indicator of FDI activities. The reason that the greater the distances the less MNCs is due to the existence of the communication cost for transferring headquarter services, which increases with the physical distance between two countries. Second, the technology parameter $c_i(T_i,T_j)$ is negatively related to FDI activities. In other words, the development of IT in either the home or foreign country will shrink the perceived physical distance between two nations and encourage FDI. Overall, the distance-related communication cost is inversely related to the number of multinational firms. Third, the number of MNCs or bilateral FDI activities is positively related to the product of two countries' population (or economic size), which is consistent with the prediction of the gravity equation.

In sum, the theoretical framework developed in this section provides a foundation for a gravity-type FDI model. That is, bilateral FDI activities are positively related to the economic sizes of the home and host countries, while it is negatively related to physical distance between the two countries, discounted by the development of IT.

3. Empirical Test

In this section, we use an IT-augmented gravity equation, justified by equation (11), to empirically test the impact of IT and distance on FDI. Although the gravity model is the most popular empirical framework for bilateral international trade, it has not been used much for FDI due to the lack of bilateral FDI data. Nonetheless, using FDI and MNC data for the U.S. and Asian countries, Brainard (1997), Blonigen and Davies

(2000), and Stone and Jeon (2000) all find the gravity model to be very successful in explaining multinational activities. More specifically, we have

$$\begin{aligned}\log FDI_{i-j,t} = {} & \alpha_t + \beta_1 \log GDP_{i,t} + \beta_2 \log GDP_{j,t} + \beta_3 \log Distance_{i-j} + \beta_4 \log IT_{i-j,t} \\ & + \beta_5 \log IT_{i-j,t} * \log Distance_{i-j} + \beta_6 openTrade_{j,t} + \beta_7 openFDI_{j,t} \\ & + \beta_8 Language_{i-j} + \beta_9 Treaty_{i-j,t} + \beta_{10} EU_{i-j} + \beta_{11} NAFTA_{i-j} + \varepsilon_{i,t} \qquad (12)\end{aligned}$$

In equation (12), $\log FDI_{i-j,t}$ is the log of FDI stocks in millions of US dollars from country i to country j at time t. $\log GDP_{i,t}$ and $\log GDP_{j,t}$ are the logs of GDP in the home and host countries, respectively. Since FDI is positively related to the home and host countries' economic sizes, the coefficients of both GDP variables are expected to be positive. $\log Distance_{i-j}$ is the log of distance in kilometers between the capital cities of country i and country j. As our theory suggests, the farther away the two countries are, the higher the communication cost and then the lower the FDI. Therefore, β_3 should be negative.

$\log IT_{i-j,t}$ is an indicator of the sophistication of the IT network between the home and host countries at time t. The IT variables are measured by the teledensity index, the number of telephone lines per 100 persons, and the celldensity index, the number of wireless phones per 100 persons in each country. The product of the teledensity (celldensity) for the host and home countries ($\log IT_{i,t} * \log IT_{j,t}$) is used to measure the development of IT over time because effective communications require an advancement of IT from both ends. In addition, we also combine teledensity and celldensity as another proxy of IT development since wireless technology has provided a fast and inexpensive way for many countries to catch up in building

communication infrastructure. To be consistent with our theory, we expect β_4 to be positive. That is, the higher the IT adoption rate for both countries, the more FDI from the home country to the host country. We also include an interactive term of the IT variable and the distance in the regression to test the hypothesis that the development of IT encourages FDI by reducing the communication cost. Without the interactive term, the impact of distance on bilateral FDI inward stocks is measured by $\partial \log FDI / \partial \log Distance = \beta_3$. When incorporating the interactive term, the impact is measured by $\partial \log FDI / \partial \log Distance = \beta_3 + \beta_5(\log IT_{i-j}) = \beta_3'$. We expect β_5 to be positive or small negative. In other words, we hypothesize that the negative role of physical distance will be reduced by the development of ITso that $\beta_3 \prec \beta_3'$.

Finally, some traditional control variables are added into the IT-augmented gravity equation. $openTrade_{j,t}$ is the host country's imports as a percentage of the GDP. This variable controls for the host country's openness to trade. A high import to GDP ratio implies that the host country has less restrictions on imports. According to the "tariff-jumping" FDI theory, less FDI activities should follow. However, if FDI and trade are complements, as found by Lipsey and Weiss (1981 and 1984), the coefficient β_6 should be positive. $openFDI_{j,t}$ measures a country's openness to FDI, which is calculated as the ratio of the host country's inward FDI flows to its GDP. Everything else being the same, a better investment environment will encourage FDI from country i to country j. In addition, four dummy variables $Language_{i-j}$, $Treaty_{i-j,t}$, EU_{i-j} and $NAFTA_{i-j}$ are included. $Language_{i-j}$ indicates whether or not the two countries speak the same language. Countries speaking the same language can communicate more easily with each other and are supposed to have more FDI activities. $Treaty_{i-j,t}$ shows whether

or not country i and j have an agreement on taxation of income and capital at year t. It is believed that a bilateral tax agreement provides a favorable environment for FDI activities. EU_{i-j} and $NAFTA_{i-j}$ suggests whether or not country i and j are members of the European Union and NAFTA (after 1994), respectively. They capture the effect of the regional economic integration on FDI movement.

Given the availability of the data, our sample includes 27 OECD countries and 20 non-OECD countries from 1980 to 1997. Since G7 countries are the major source of FDI activity, we focus our study on the FDI from G7 countries to all other countries. The data sources and the definitions of the variables used in this study are described in the Appendix. The descriptive statistics of all variables are reported in Table 1.

Table 2 presents the estimation results for inward FDI stocks using OLS regression.[3] All regressions take the time fixed effect into account and we use the robust estimators of variance that allow for correlation in repeated observations for the same pairs of countries. In column (1) – (4), we run regressions with the host-country fixed effect. We first use teledensity as a proxy of IT development in column (1). Then we combine teledensity and celldensity as an alternative proxy for the IT variable in column (3). The interactive term of the IT variable and distance are included in columns (2) and (4). In columns (5) – (8), the regressions control for the country-pair fixed effect, producing higher R^2. The coefficients of the year and country dummies are not shown in the table due to space constraints.

[3] We use FDI stocks rather than FDI flows because there were many negative and zero numbers in the FDI flow data. The estimation results using FDI flows with a smaller number of observations were not much different from the results using the FDI stocks.

As we can see, the coefficient on distance is always negative and significant. The distance elasticity of inward FDI stock is in the range of -0.79 to -0.84.[4] This is consistent with our communication cost assumption for managing multinationals. The communication costs for sharing headquarter services increase with the distance between two countries. Hence, less FDI activities are expected. As expected, the coefficient of the interactive term is either positive or small negative. We should note that after including the interactive term of IT variable and distance in columns (2) and (4), the overall elasticity of distance on FDI is $\beta_3 + \beta_5(\log IT_{i-j})$. Given that the mean of $\log IT_{i-j,t}$ is 10.24, the overall distance elasticity is -0.8019 and -0.8255 respectively. Based on the results in Table 2, it is not obvious whether the development of IT has reduced the negative role of distance on FDI.

Nonetheless, we do find that the growth of IT for a country pair encourages FDI. The coefficient on the IT variable is always positive and statistically significant. More specifically, the coefficient on the IT variable is 0.217 in column (7) without the interactive term, while it ranges from 0.177 to 0.435 with the interactive term according to column (8).[5] It implies that any one percent increase in the IT network will increase a country's inward FDI stocks by 0.18 to 0.44 percent.

To test the robustness of our results, we utilize sub-sample analysis using the country-pair fixed effect model, which produces a higher R^2 than the host-country only fixed effect. We first split the data into two groups: for FDI from G7 to OECD countries and from G7 to non-OECD countries. The results are reported in Table 3. We find that

[4] Distance is dropped in the country-pair fixed effect model, since it does not vary over time. For similar reasons, *Language* and *EU* dummies are dropped as well.
[5] The overall elasticity of IT on FDI is (0.8613-0.0795*logDistance). The range is calculated using minimum and maximum of logDistance, which is 5.27 and 9.85 respectively.

the growth of teledensity and celldensity encourages more FDI from G7 to OECD countries than from G7 to non-OECD countries. For example, one percent increase in the global telephone network will increase FDI inward stocks by 0.83 for OECD countries while only by 0.17 for non-OECD countries. Similar results are found when aggregating teledensity and celldensity as a proxy of IT development. The finding suggests that FDI between developed countries requires more communications than that between developed and developing countries. Hence, the development of IT tends to have larger impact on FDI between G7 and other OECD countries.

Next, we divide the data into two time periods: the 1980s and the 1990s. As we can see in Table 4, the coefficient of the IT variable is not significant in the 1980s while it turns out to be very significant in the 1990s, implying a more prominently favorable role of the development of IT in enhancing the FDI activities in the 1990s than in the 1980s. Also, the interactive term of IT and distance become statistically significantin the 1990s.[6]

An interesting finding is reported in Table 5 after we split the whole sample into two groups by distance. In columns (1) – (4), the distance between the capital cities of the two countries is less than the average distance of our whole sample, which is 4,722 km, while in columns (5) – (8), the distance is greater than the average distance in the sample. All regressions employ the aggregation of teledensity and celldensity as a proxy of the IT variable. When the distance is shorter than the average distance, the elasticity of distance is always negative and significant. After we introduce the interactive term of IT and distance into the regression, the IT variable becomes insignificant and the overall

[6] Since all regressions in Tables 3 and 4 include country-pair and time dummies, distance is dropped as it does not vary over time. Consequently, we are unable to evaluate the change of the elasticity of distance with respect to FDI when the interactive term of IT and distance is included.

elasticity of distance becomes more negative (-1.346<-1.275)[7]. On the other hand, when distance is larger than the average distance, the elasticity of distance is not significant with the interactive term and the overall elasticity of distance becomes less negative (-1.140>-1.154)[8]. In addition, the IT variable turns to be much more significant. These findings suggest that IT becomes more effective in reducing the communication cost and encouraging FDI when the distance between the home and host countries is larger than the average distance, although its marginal impact seems to decrease.

Overall, the IT-augmented gravity model performs quite well in explaining the bilateral FDI activities. All regressions have a R-square above 70 percent. Specifically, the values of R-square are above 90 percent in the regressions with the country-pair fixed effect, which are much higher than the R-squares from the regressions with the host-country fixed effect.

Moreover, almost all of the traditional variables in a gravity equation return expected signs. Both the home and host country's GDP are positive, which indicates the importance of market size for FDI activity. In addition, $openFDI_{j,t}$ is positively related to FDI as expected because the high openness to FDI attracts more international investors. The coefficient of $openTrade_{j,t}$ is negative and significant in most cases, which supports the "tariff-jumping" theory. Language and a bilateral treaty are important determinants for bilateral FDI after controlling for the host-country fixed effect. The evidence for the impact of regional economic integration on FDI are mixed. Although NAFTA seems to encourage FDI from the US and Canada to Mexico according to the

[7] The overall elasticity of distance is equal to (-1.6034+0.0216*logIT), where logIT is the mean of logIT in the sub-sample.
[8] Similarly, the overall elasticity of distance is equal to (-0.3503-0.0795*logIT), where logIT is the mean of logIT in the sub-sample.

sub-sample analysis in Table 3, we do not find integration in Europe to encourage bilateral FDI between member countries. Frankel (1997) gives similar results for bilateral trade between EU member countries. Part of the reason is due to the fact that the progress of regional economic integration in Europe has been rather gradual since the Treaty of Rome in 1957, compared with the economic integration in North America, which culminated in mid 1990s. Therefore, our dummy variable for NAFTA captured significant growth of FDI after 1994 while no obvious growth occurred in FDI between EU member countries during the period between 1980 and 1997.

4. Conclusion

This paper offers a theory based empirical analysis on the impact of IT on FDI activities by MNCs. We provide a theoretical justification for using the an IT-augmented FDI gravity model. We find that distance is an important impediment to bilateral FDI due to the high communication cost of sharing information, knowledge and other intangible assets within MNCs. In addition, we provided empirical evidence that the joint development of IT in the home and host countries encourages FDI significantly. In particular, IT has a more remarkably favorable impact on FDI activities from G7 to OECD countries, compared to non-OECD countries, and the impact is more significant during the 1990s than the 1980s. Moreover, an investigation of the interaction term between IT and distance and the total elasticity of FDI with respect to distance confirms that IT encourages FDI by decreasing the perceived distance between countrieswhen distance is beyond a threshold range.

Thefindings in this paper have important policy implications for the FDI policy in a host country. It is suggested that the development of a modern communication infrastructure should be high on the priority list for countries in order to attract FDI. In addition, the role of multinational headquarters as an information-processing center is strengthened with modern communication technology. In other words, multinational firms are better able to disperse operations globally while coordinating and leveraging production and financial management more efficiently over long distances due to the recent development of information technology.

Table 1. Descriptive Statistics of Variables

Variable	Description	Mean	Std. Dev.	Min	Max
$\log FDI_{i-j}$	log of FDI stocks from country i to country j	6.1243	2.4415	-1.9800	13.0237
$\log GDP_j$	log of GDP in the host country	4.7417	1.3656	0.9821	9.0240
$\log GDP_i$	log of GDP in the home country	7.0799	0.8658	5.5722	9.0240
$\log Dis\tan ce_{i-j}$	log of distance between the capital cities of country i and country j	8.4583	1.0184	5.2743	9.8526
$\log IT_{i-j}$	Log of teledensity in the home country times log of teledensity in the host country	10.2429	5.3256	-5.8107	19.7632
	Log of (teledencity+celldensity) in the home country times log of (teledencity+celldensity) in the host country	10.6382	5.6472	-5.8107	21.9667
$openTrade_j$	openness to trade in host country	35.4884	30.2679	4.6313	223.6470
$openFDI_j$	openness to FDI in host country	1.4656	2.0272	-0.8424	15.2025
$\log IT_{i-j}$ * $\log Dis\tan ce$	the interaction term of logIT(teledensity) and logDistance	85.1339	45.1088	-54.1536	172.6459
	The interaction term of logIT(teledensity+celldensity) and logDistance	88.2520	47.8820	-54.1536	199.6993

Note: FDI, GDP are in billions of US dollars. Distance is in kilometers. Teledensity is the number of telephone lines per 100 residents and celldensity is the number of cell phones per 100 residents. OpenTrade and openFDI are all in percentages.

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Table 2. Information Technology and Inward FDI Stocks

	With host dummy				With country pair dummy			
	IT=tele	IT=tele	IT=tele+cell	IT=tele+cell	IT=tele	IT=tele	IT=tele+cell	IT=tele+cell
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$logGDP_{j,t}$	0.1977	0.1973	0.2651	0.2657	0.4367***	0.4177***	0.5057***	0.4965***
	(1.10)	(1.09)	(1.48)	(1.48)	(2.86)	(2.80)	(3.31)	(3.32)
$logGDP_{i,t}$	1.2253***	1.2257***	1.1848***	1.1849***	0.6455***	0.5896**	0.6248***	0.6038**
	(17.60)	(17.60)	(16.86)	(16.87)	(2.75)	(2.54)	(2.59)	(2.52)
$logDistance_{i-j}$	-0.7946***	-0.8388***	-0.8273***	-0.8041***				
	(-8.23)	(-3.60)	(-8.54)	(-3.58)				
$logIT_{i,t}*logIT_{j,t}$	0.3127***	0.2815*	0.3521***	0.3682**	0.2105***	0.8873***	0.2165***	0.7324***
	(5.24)	(1.75)	(5.44)	(2.31)	(4.45)	(3.80)	(4.33)	(3.79)
logIT*logDistance		0.0036		-0.0018		-0.0760***		-0.0564***
		(0.22)		(-0.12)		(-3.13)		(-2.99)
$openTrade_{j,t}$	-0.0179***	-0.0181***	-0.0213***	-0.0212***	-0.0135***	-0.0113**	-0.0150***	-0.0129**
	(-3.22)	(-3.25)	(-3.58)	(-3.61)	(-2.70)	(-2.48)	(-2.86)	(-2.72)
$openFDI_{j,t}$	0.0871***	0.0874***	0.0818**	0.0815**	0.0938***	0.0909***	0.0943***	0.0883***
	(2.67)	(2.67)	(2.47)	(2.47)	(2.95)	(3.03)	(2.92)	(2.87)
language	0.6494***	0.6512***	0.6461***	0.6453***				
	(2.74)	(2.74)	(2.72)	(2.71)				
treaty	0.5079***	0.5101***	0.5152***	0.5139***	-0.0184	0.0440	-0.0332	0.0141
	(3.28)	(3.31)	(3.33)	(3.33)	(-0.05)	(0.12)	(-0.09)	(0.04)
EU	-0.1334	-0.1207	-0.1496	-0.1557				
	(-0.47)	(-0.42)	(-0.52)	(-0.54)				
NAFTA	-0.1611	-0.1528	-0.1581	-0.1642	-0.0077	-0.1697	0.0547	-0.1082
	(-0.42)	(-0.40)	(-0.36)	(-0.38)	(-0.04)	(-0.80)	(0.28)	(-0.44)
No. of observation	4232	4232	4014	4014	4232	4232	4014	4014
R-square	0.729	0.729	0.731	0.731	0.904	0.906	0.905	0.907

Note: *, **, *** significant at the 10%, 5% and 1% levels, respectively.

Table 3. IT and Inward FDI Stocks, G7 to OECD vs. non-OECD countries (with the country-pair fixed effect)

	OECD countries				Non-OECD countries			
	IT=tele	IT=tele	IT=tele+cell	IT=tele+cell	IT=tele	IT=tele	IT=tele+cell	IT=tele+cell
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$logGDP_{j,t}$	0.3458	0.3460	0.8346**	0.7805**	0.3127*	0.3169*	0.3289*	0.3365*
	(1.05)	(1.04)	(2.48)	(2.35)	(1.78)	(1.80)	(1.74)	(1.79)
$logGDP_{i,t}$	0.7589***	0.7611***	0.8655***	0.8810***	0.6551*	0.5907*	0.6379*	0.5556
	(2.88)	(2.87)	(3.24)	(3.28)	(2.88)	(1.70)	(1.67)	(1.49)
$logIT_{i,t}$*$logIT_{j,t}$	0.8346***	0.8966***	0.7402***	1.0629***	0.1735***	0.3667	0.1449***	0.3867
	(6.24)	(4.06)	(5.20)	(4.64)	(3.36)	(1.08)	(2.68)	(1.31)
logIT*logDistance		-0.0086		-0.0392**		-0.0220		-0.0276
		(-0.33)		(-2.03)		(-0.57)		(-0.83)
$openTrade_{j,t}$	-0.0255**	-0.0253**	-0.0228**	-0.0210*	-0.0051	-0.0048	-0.0073*	-0.0069
	(-2.44)	(-2.41)	(-2.00)	(-1.94)	(-1.23)	(-1.16)	(-1.69)	(-1.60)
$openFDI_{j,t}$	0.0985**	0.0987**	0.0905*	0.0858*	0.0532**	0.0543**	0.0610**	0.0624***
	(2.25)	(2.26)	(1.84)	(1.77)	(2.51)	(2.56)	(2.62)	(2.68)
treaty	0.3062	0.3296	0.4246	0.5357	-0.0610	-0.0727	-0.1135	-0.1375
	(0.47)	(0.49)	(0.58)	(0.73)	(-0.20)	(-0.23)	(-0.34)	(-0.40)
NAFTA	-0.0904	-0.1125	0.0276	0.1418	0.4260**	0.3696	0.3916*	0.3082
	(-0.49)	(-0.58)	(0.19)	(0.84)	(2.15)	(1.62)	(1.93)	(1.36)
No. of observation	2500	2500	2397	2397	1732	1732	1617	1617
R-square	0.918	0.918	0.915	0.916	0.893	0.894	0.895	0.896

Note: *, **, *** significant at the 10%, 5% and 1% levels, respectively.

Table 4. IT and Inward FDI Stocks, the 1980s vs. the 1990s (with the country-pair fixed effect)

	1980-1989				1990-1997			
	IT=tele	IT=tele	IT=tele+cell	IT=tele+cell	IT=tele	IT=tele	IT=tele+cell	IT=tele+cell
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$logGDP_{j,t}$	0.3987***	0.3971***	0.3974**	0.4122**	0.4183***	0.5286***	0.4727***	0.5918***
	(2.87)	(2.87)	(2.55)	(2.66)	(2.92)	(3.75)	(3.28)	(4.05)
$logGDP_{i,t}$	0.6848***	0.6867***	0.6891***	0.6712***	0.0198	0.0486	0.0672	0.1269
	(3.42)	(3.34)	(3.27)	(3.11)	(0.06)	(0.15)	(0.21)	(0.41)
$logIT_{i,t}$*$logIT_{j,t}$	0.1221	0.1365	0.1246	0.0038	0.1396***	1.3419***	0.1194***	0.8613***
	(1.38)	(0.67)	(1.25)	(0.02)	(3.65)	(3.71)	(2.73)	(3.59)
logIT*logDistance		-0.0017		0.0144		-0.1340***		-0.0795***
		(-0.07)		(0.61)		(-3.46)		(-3.27)
$openTrade_{j,t}$	-0.0022	-0.0022	0.0012	0.0015	-0.0062	-0.0047	-0.0058	-0.0053
	(-0.40)	(-0.41)	(0.26)	(0.33)	(-1.36)	(-1.09)	(-1.20)	(-1.15)
$openFDI_{j,t}$	0.0488*	0.0490*	0.0979***	0.0966***	0.0207	0.0123	0.0244	0.0150
	(1.83)	(1.85)	(2.67)	(2.70)	(0.74)	(0.46)	(0.85)	(0.53)
treaty	-0.3309*	-0.3301*	-0.4825***	-0.4896***	0.9805	1.0367	1.0041	1.0674
	(-1.94)	(-1.91)	(-3.65)	(-3.69)	(1.45)	(1.55)	(1.51)	(1.63)
NAFTA					-0.0943	-0.1500	-0.0677	-0.1421
					(-0.45)	(-0.66)	(-0.31)	(-0.55)
# of observation	2010	2010	1792	1792	2222	2222	2222	2222
R-square	0.958	0.958	0.959	0.959	0.931	0.933	0.930	0.932

Note: *, **, *** significant at the 10%, 5% and 1% levels, respectively.

Table 5. IT and Inward FDI Stocks by Distance (IT=teledensity+celldensity)

	Short-Distance Pair Countries[a]				Long-Distance Pair Countries[b]			
	With host dummy		With country pair dummy		With host dummy		With country pair dummy	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$logGDP_{j,t}$	0.5901**	0.5961**	0.6186**	0.6098**	0.2416	0.2640	0.5148***	0.5209***
	(2.16)	(2.19)	(2.22)	(2.20)	(1.17)	(1.32)	(2.70)	(2.82)
$logGDP_{i,t}$	1.0761***	1.0690***	0.1782	0.1871	1.1930***	1.2050***	0.7263***	0.7598***
	(8.79)	(8.53)	(0.35)	(0.37)	(15.80)	(16.19)	(2.59)	(2.75)
$logDistance_{i-j}$	-1.2750***	-1.6034**			-1.1537***	-0.3503		
	(-3.91)	(-1.96)			(-4.92)	(-0.55)		
$logIT_{i,t}$*$logIT_{j,t}$	0.3182***	0.1436	0.3131***	0.5917*	0.3722***	1.0933**	0.2134***	1.1051*
	(2.72)	(0.32)	(2.89)	(1.77)	(5.15)	(2.36)	(3.73)	(1.66)
logIT*logDisance		0.0216		-0.0339		-0.0795		-0.0966
		(0.38)		(-0.89)		(-1.63)		(-1.38)
$openTrade_{j,t}$	-0.0221*	-0.0233*	-0.0165	-0.0149	-0.0179***	-0.0173***	-0.0122**	-0.0118**
	(-1.73)	(-1.79)	(-1.29)	(-1.18)	(-3.05)	(-2.94)	(-2.53)	(-2.43)
$openFDI_{j,t}$	0.1814**	0.1865**	0.1580**	0.1509**	0.0400	0.0422	0.0603**	0.0601**
	(2.42)	(2.52)	(2.05)	(2.03)	(1.40)	(1.50)	(2.26)	(2.28)
language	-0.1538	-0.1726			0.9139***	0.9252***		
	(-0.36)	(-0.41)			(3.08)	(3.13)		
treaty	0.4404**	0.4489**	-1.2115*	-1.1696*	0.6214***	0.5615**	0.3881	0.3679
	(2.08)	(2.19)	(-1.72)	(-1.65)	(2.70)	(2.45)	(0.93)	(0.94)
NAFTA	-0.1008	-0.1214	-0.0355	-0.0068				
	(-0.45)	(-0.55)	(-0.13)	(-0.02)				
# of observations	1522	1522	1522	1522	2492	2492	2492	2492
R-square	0.804	0.804	0.897	0.897	0.739	0.742	0.916	0.917

Note: *, **, *** significant at the 10%, 5% and 1% levels, respectively. a Distance < 4,722 km, b Distance > 4,722 km. The average distance between the home and host countries among the 47 countries under investigation is computed using lnDistance = 8.46

Appendix

The bilateral FDI statistics used in this study are from the *International Direct Investment Statistics Yearbook* published annually by the OECD since 1993. Since the data is relatively new, we will discuss it in detail here. The data covers inward and outward FDI flows and stock to (from) OECD countries from (to) the rest of the world. The time period for this database is between 1980 and 1997. The statistics are based mainly on the balance-of-payment data compiled by the central banks or the statistical offices of OECD countries. There are limitations in data comparability due to differences in national definitions. According to the IMF's definition, FDI refers to investments by a resident in another country that lead to 10 percent or more of the ordinary shares or voting power. FDI should have three components: equity capital, reinvested earnings, and inter-company debt. In fact, not all countries have used the 10 percent ownership threshold to define FDI until recent years. The comparability of the FDI data is particularly hampered by the fact that reinvested earnings and inter-company loans were not included in the data for Belgium-Luxemburg and Denmark until 1992, or Greece, Hungary, Japan, Korea, and Portugal until 1996.

In addition, FDI flows are used to estimate missing FDI stocks. Since the FDI statistics between two OECD member countries are reported as FDI inflows by the host country and as outflows by the source country, the inflow and outflow data between the same country pair should be the same in theory. However, due to national differences in FDI definition, currency and statistical errors, they are different most of the time. Nonetheless, the FDI data reported by the host and source countries are highly correlated, with the correlation coefficient above 90 percent. Therefore, we mainly use the FDI data

compiled by a host country while using the information reported by a source country to make up missing values.

The GDP, GDP per capita, teledensity, and celldensity data are from the *World Telecommunications Indicators* published by the International Telecommunications Union. The ratios of a country's imports and inward FDI relative to GDP are from the World Bank's *World Development Indicators*. The bilateral income and capital tax agreement information is collected from the website of Oceana Publications (www.oceanalaw.com).

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